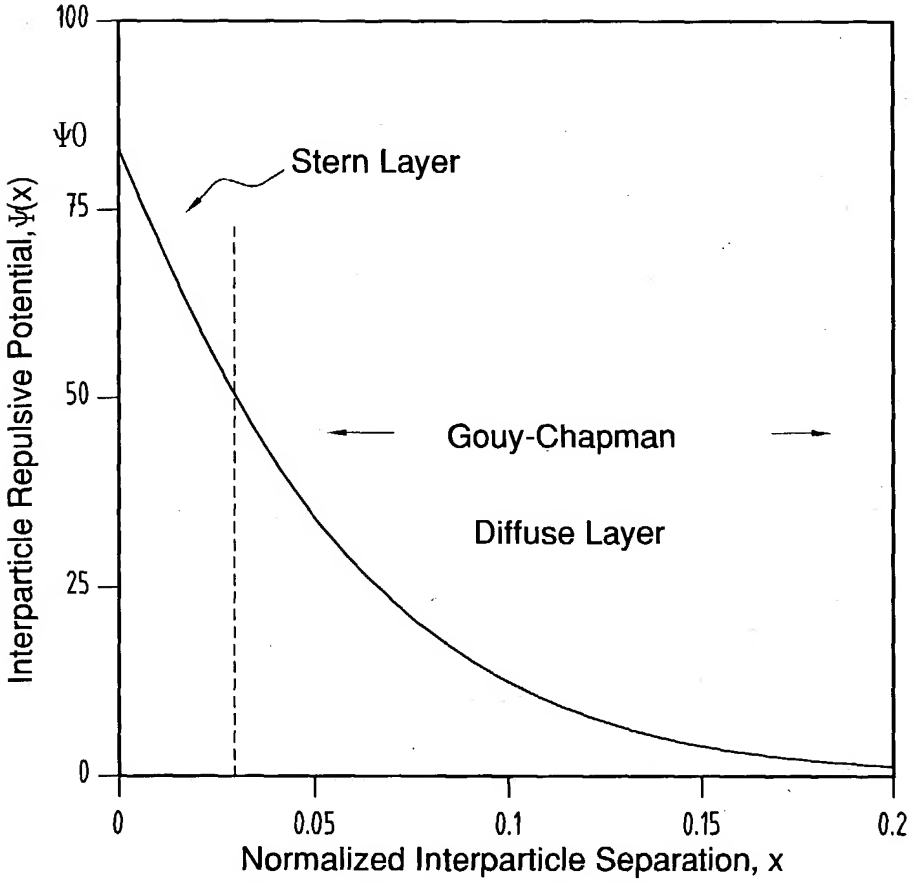

100
Ψ0
75
50
25
0
Interparticle Repulsive Potential, Ψ(x)
Stern Layer
Gouy-Chapman
Diffuse Layer
0
0.05
0.1
0.15
0.2
Normalized Interparticle Separation, x

FIG.1

FIG.2

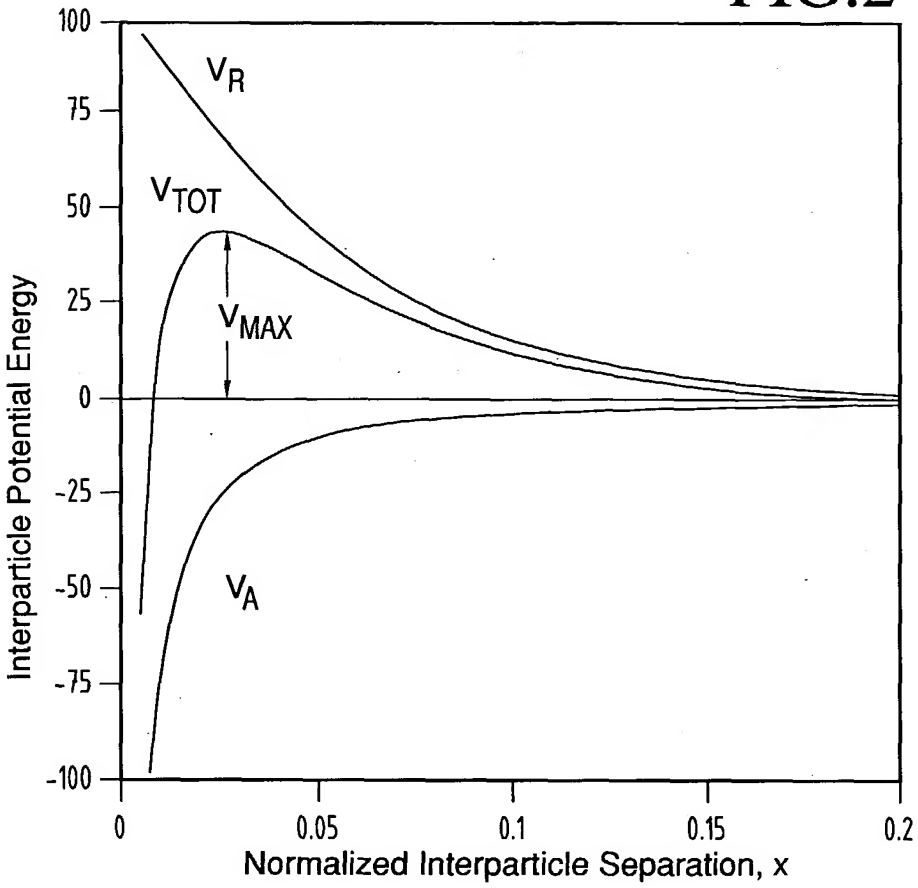

100
75
50
25
0
-25
-50
-75
-100
0
0.05
0.1
0.15
0.2
V_R
V_{TOT}
V_{MAX}
V_A
Interparticle Potential Energy
Normalized Interparticle Separation, x

FIG.3

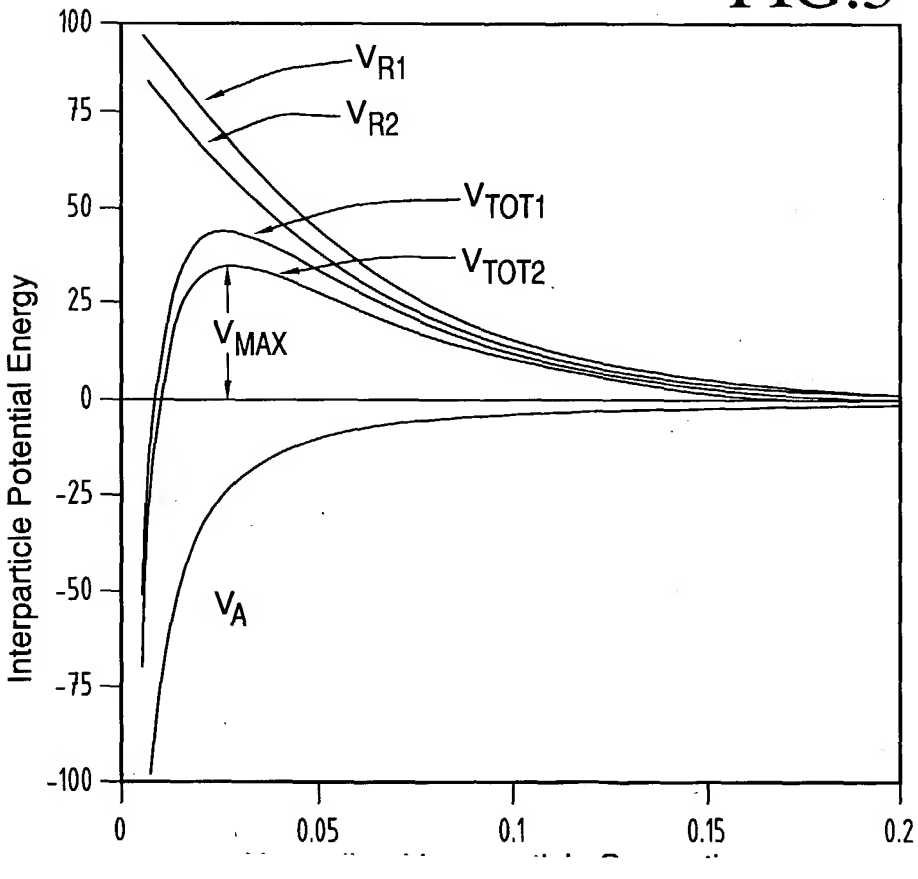

100
75
50
25
0
-25
-50
-75
-100
0
0.05
0.1
0.15
0.2
V_{R1}
V_{R2}
V_{TOT1}
V_{TOT2}
V_{MAX}
V_A
Interparticle Potential Energy

FIG.4A

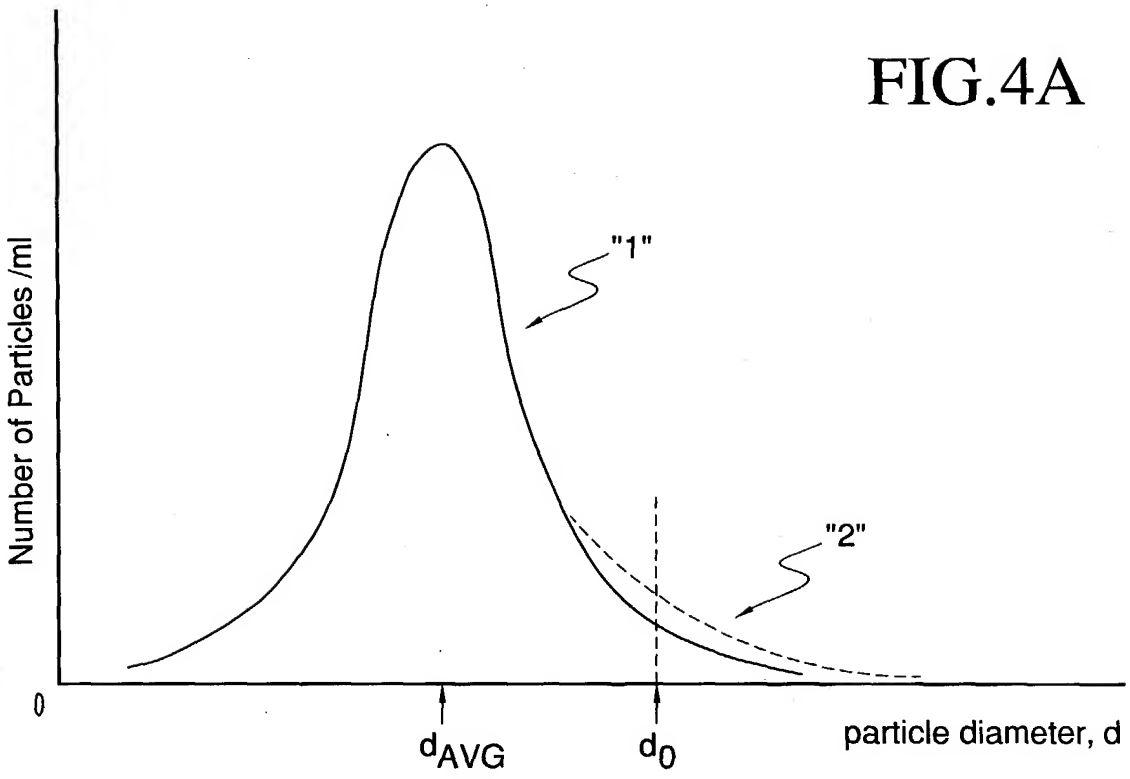

Number of Particles /ml
"1"
"2"
0
d_{AVG}
d_0
particle diameter, d

FIG.4B

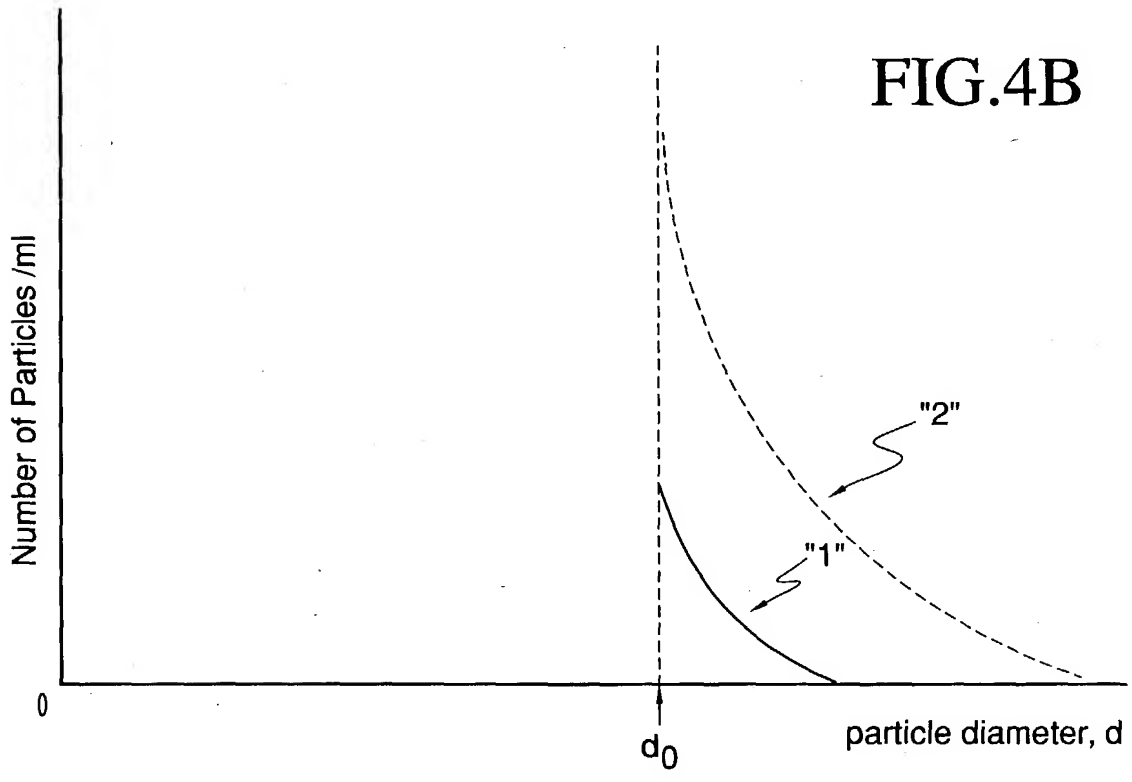

Number of Particles /ml
"2"
"1"
0
d_0
particle diameter, d

FIG.5

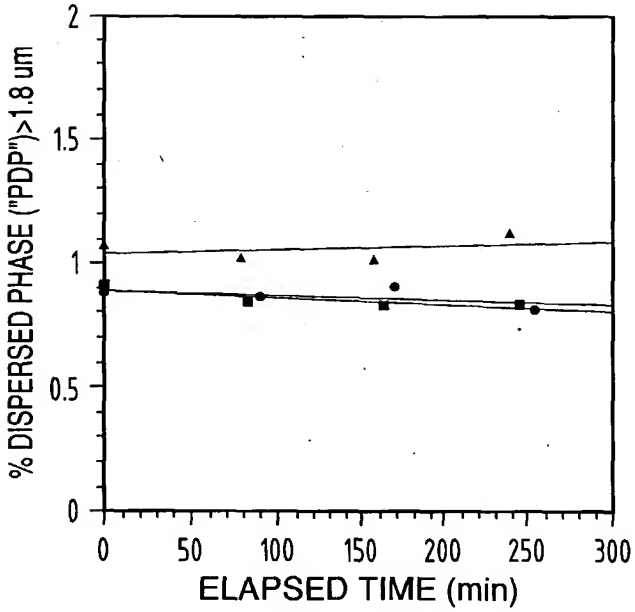


FIG.6

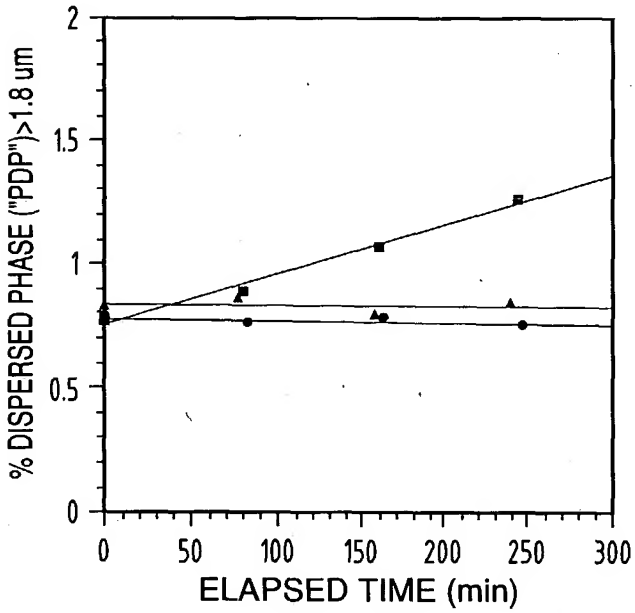
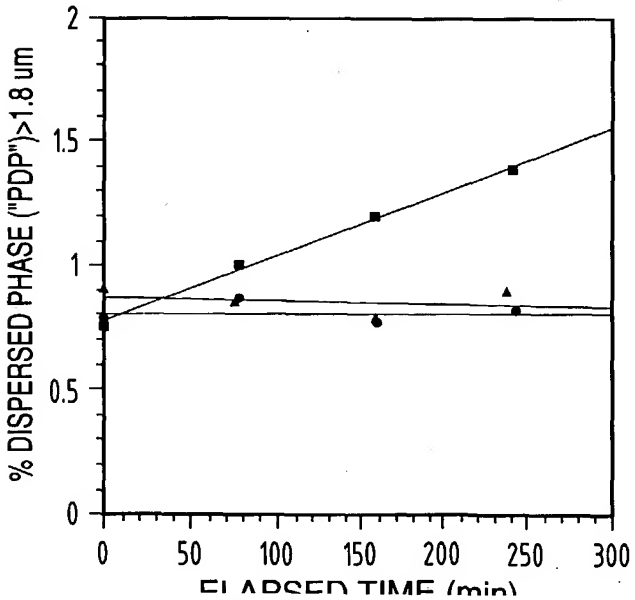


FIG.7



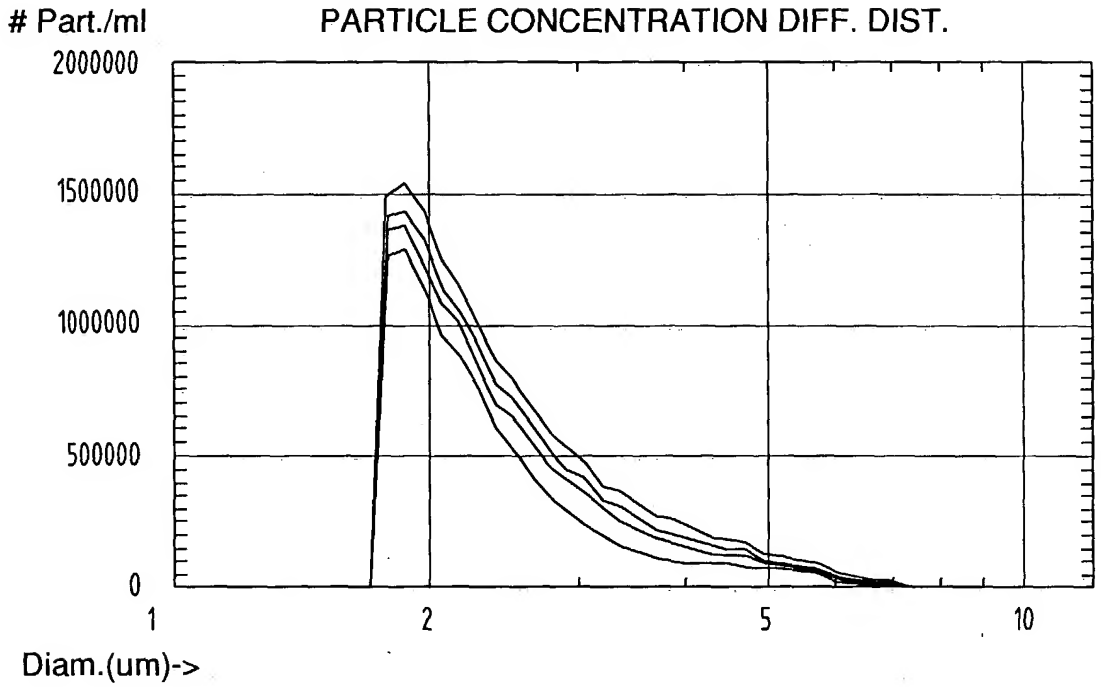

Part./ml
PARTICLE CONCENTRATION DIFF. DIST.
2000000
1500000
1000000
500000
0
1
2
5
10
Diam.(um)->

FIG.8

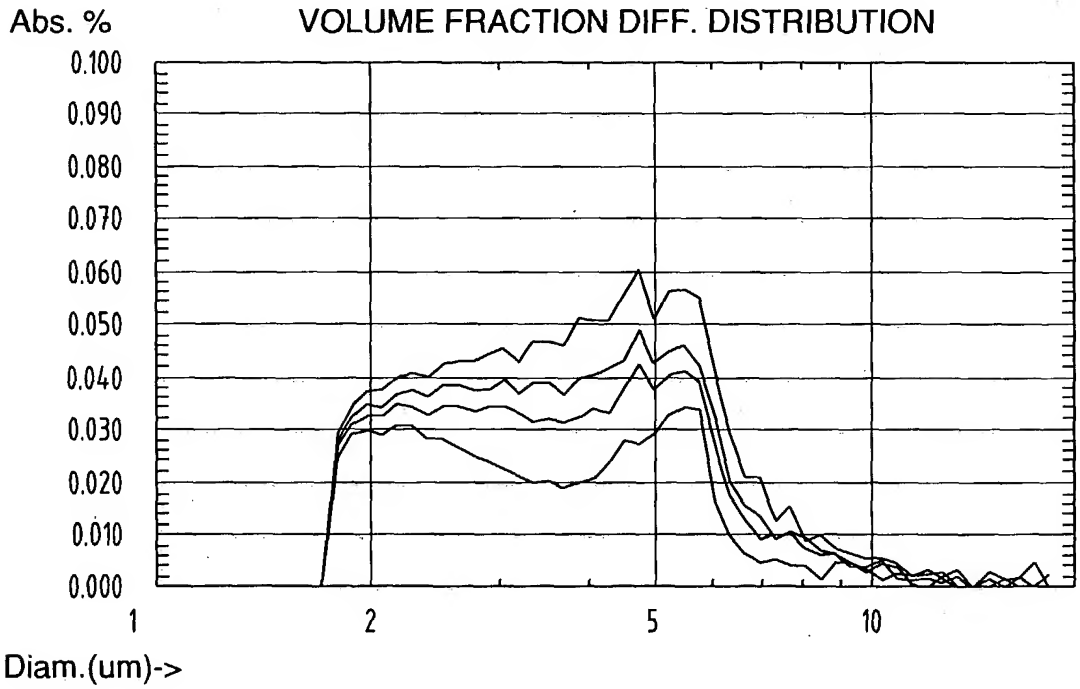

Abs. %
VOLUME FRACTION DIFF. DISTRIBUTION
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
1
2
5
10
Diam.(um)->

FIG.9

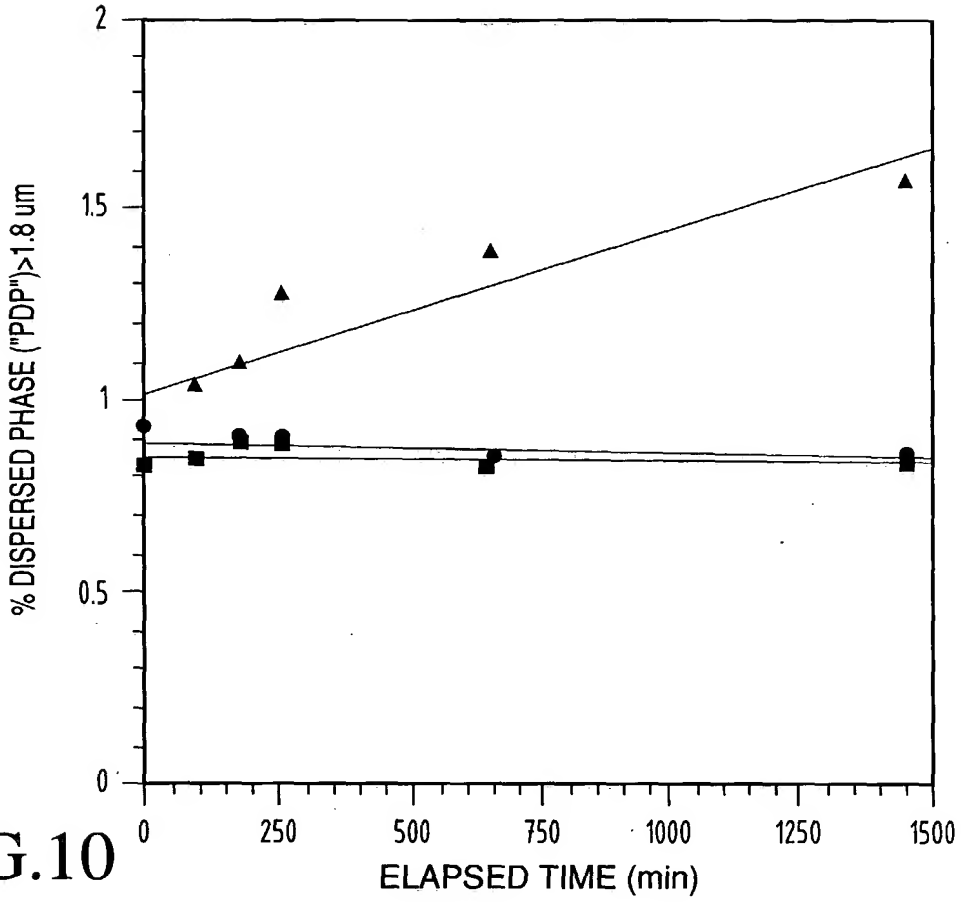

% DISPERSED PHASE ("PDP")>1.8 um
2
1.5
1
0.5
0
0
250
500
750
1000
1250
1500
ELAPSED TIME (min)

FIG.10

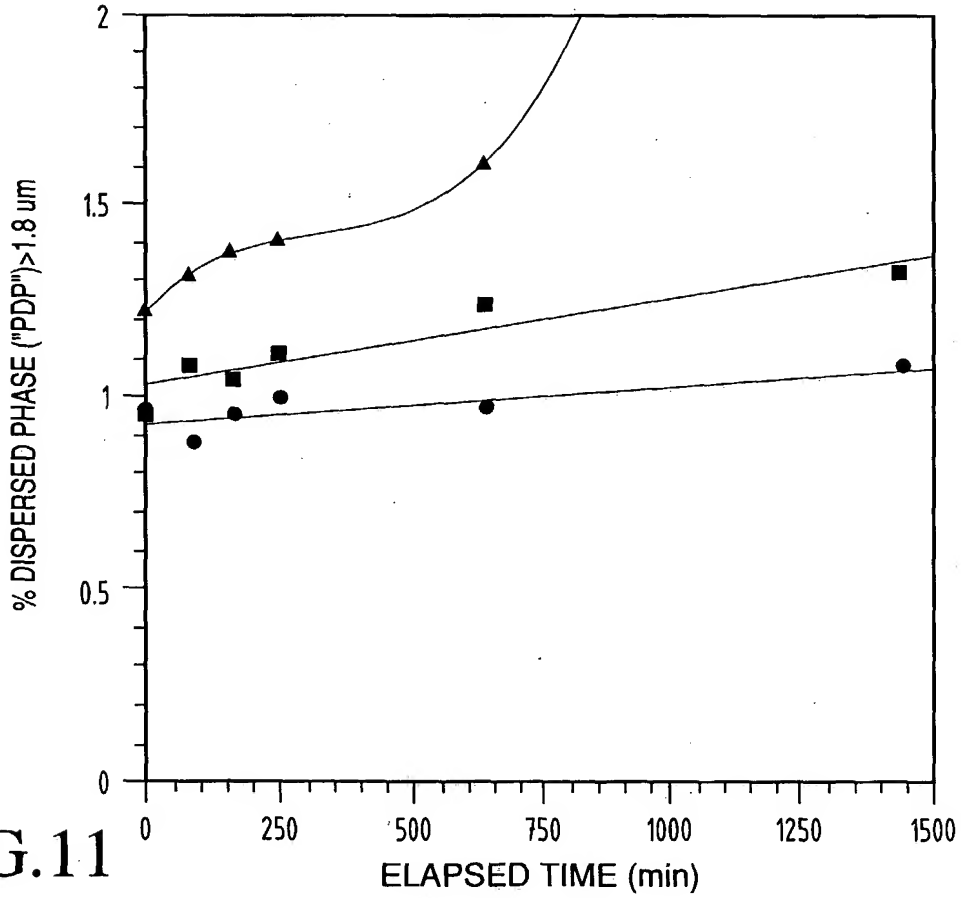

% DISPERSED PHASE ("PDP")>1.8 um
2
1.5
1
0.5
0
0
250
500
750
1000
1250
1500
ELAPSED TIME (min)

FIG.11

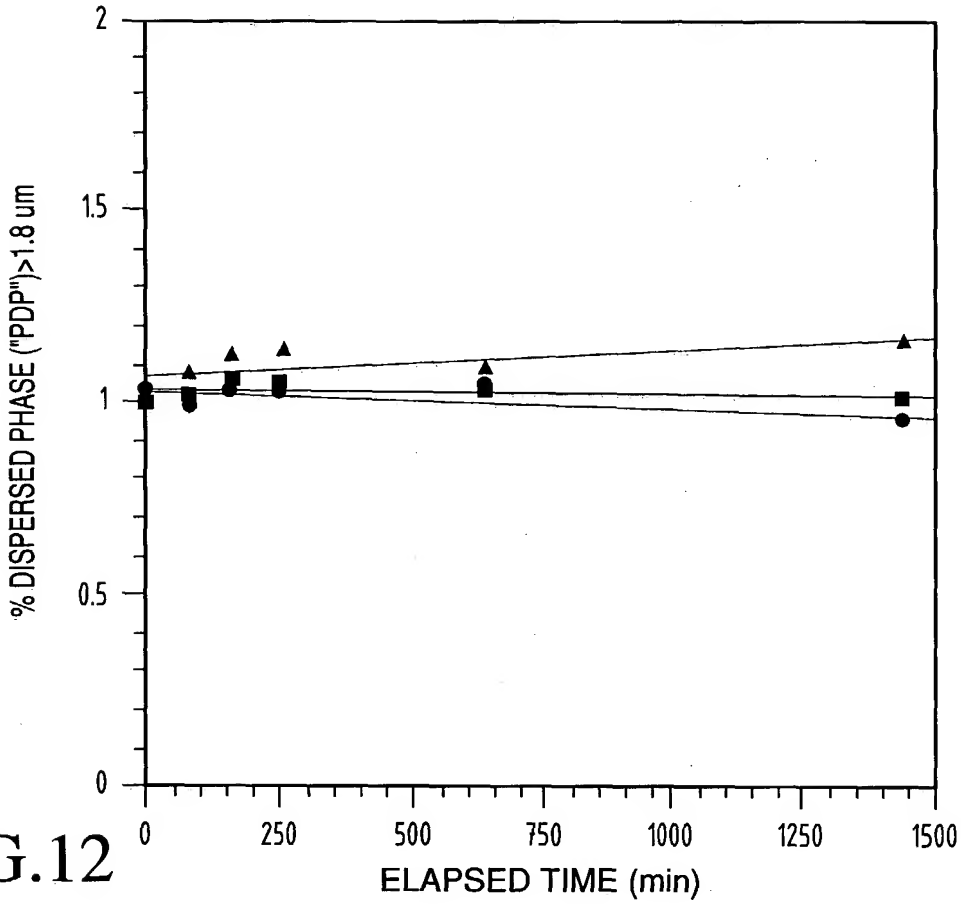

% DISPERSED PHASE ("PDP")>1.8 um
2
1.5
1
0.5
0
0
250
500
750
1000
1250
1500
ELAPSED TIME (min)

FIG.12

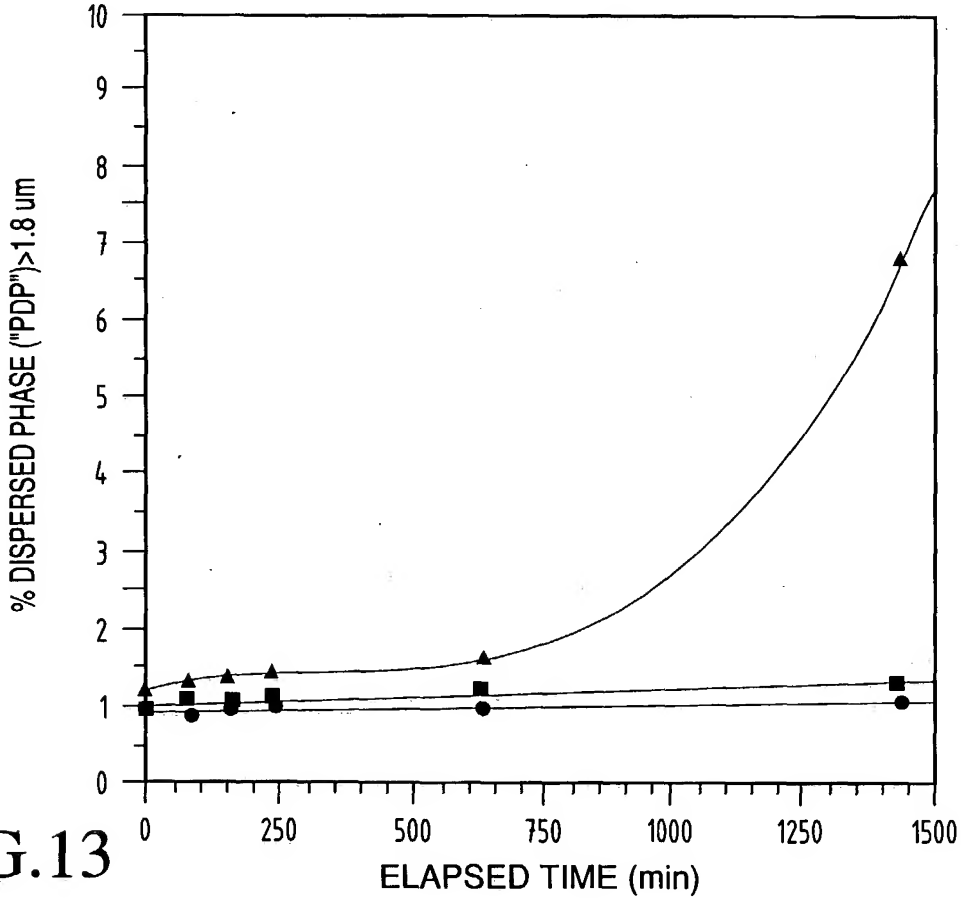

% DISPERSED PHASE ("PDP")>1.8 um
10
9
8
7
6
5
4
3
2
1
0
0
250
500
750
1000
1250
1500
ELAPSED TIME (min)

FIG.13

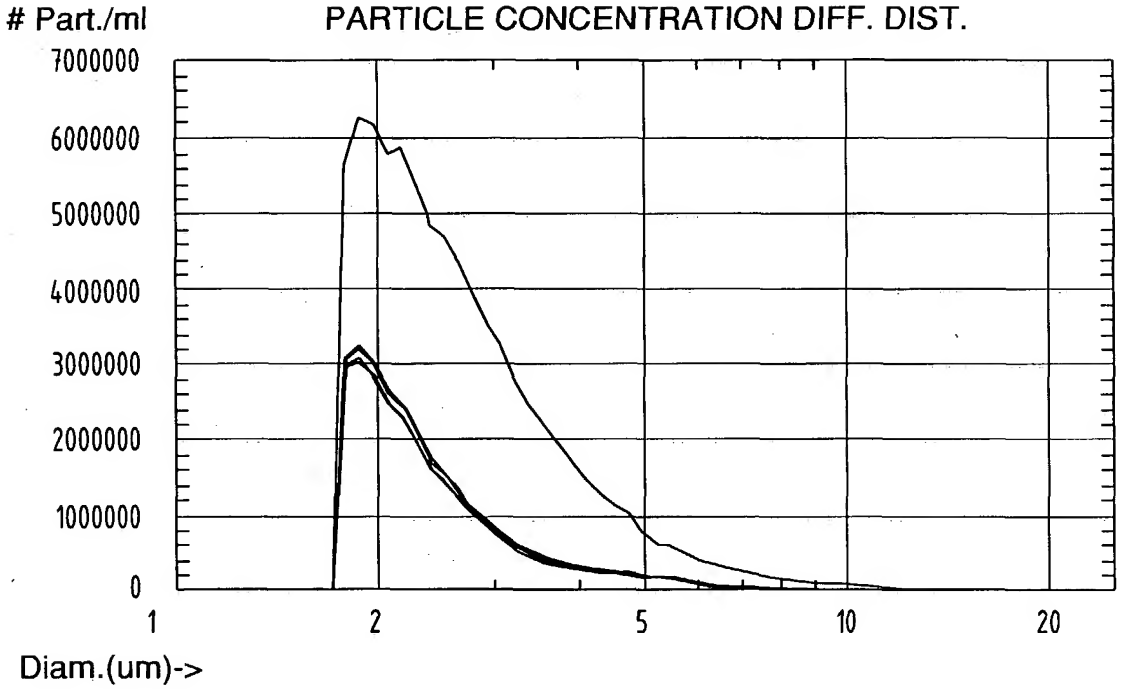

Part./ml
PARTICLE CONCENTRATION DIFF. DIST.
7000000
6000000
5000000
4000000
3000000
2000000
1000000
0
1
2
5
10
20
Diam.(um)->

FIG.14

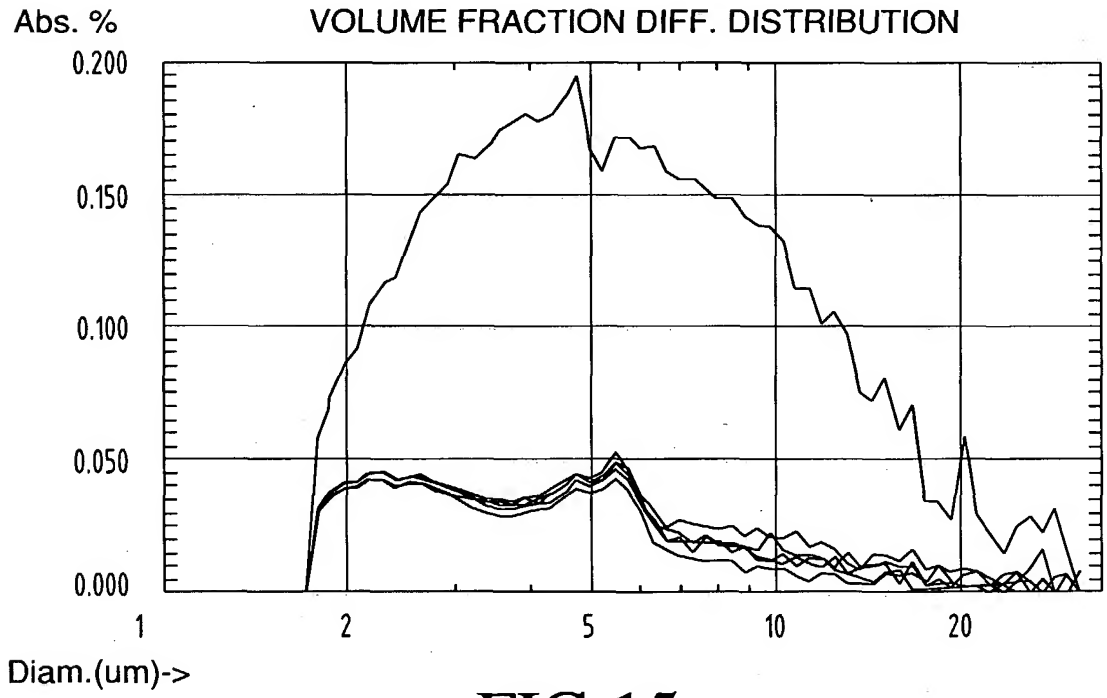

Abs. %
VOLUME FRACTION DIFF. DISTRIBUTION
0.200
0.150
0.100
0.050
0.000
1
2
5
10
20
Diam.(um)->

FIG.15

FIG.16

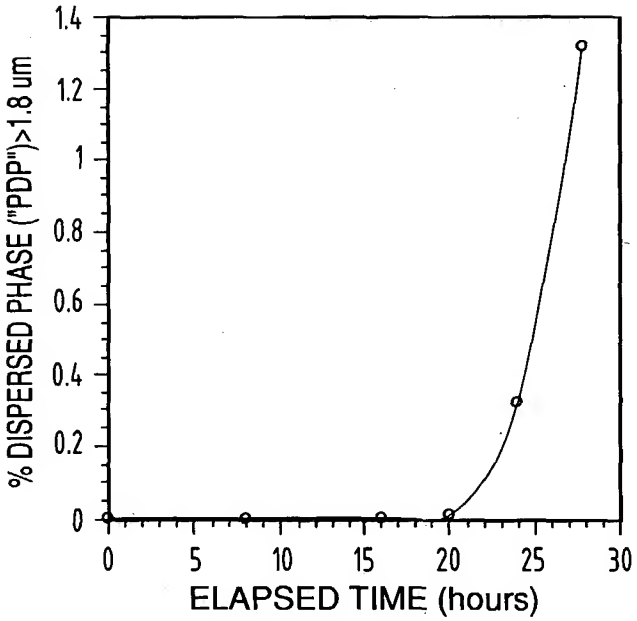


FIG.17

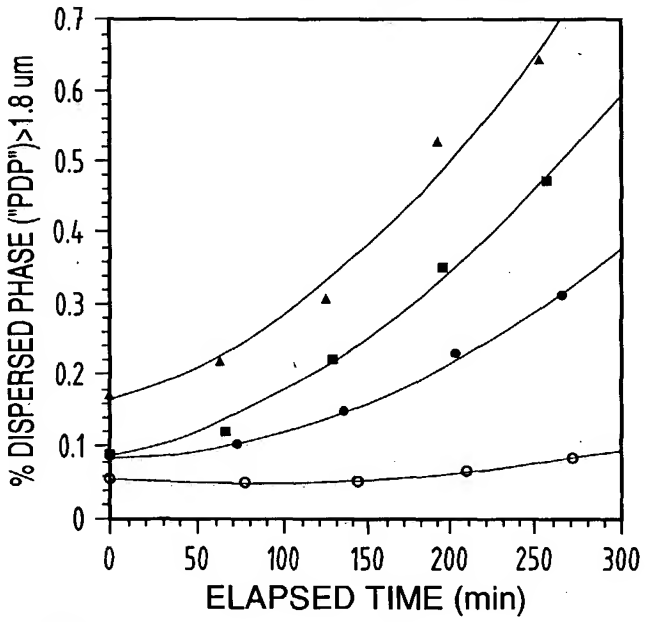
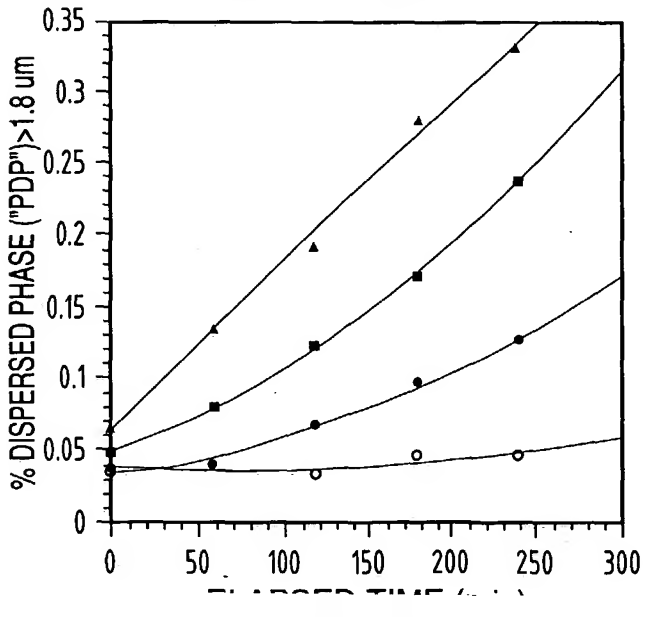
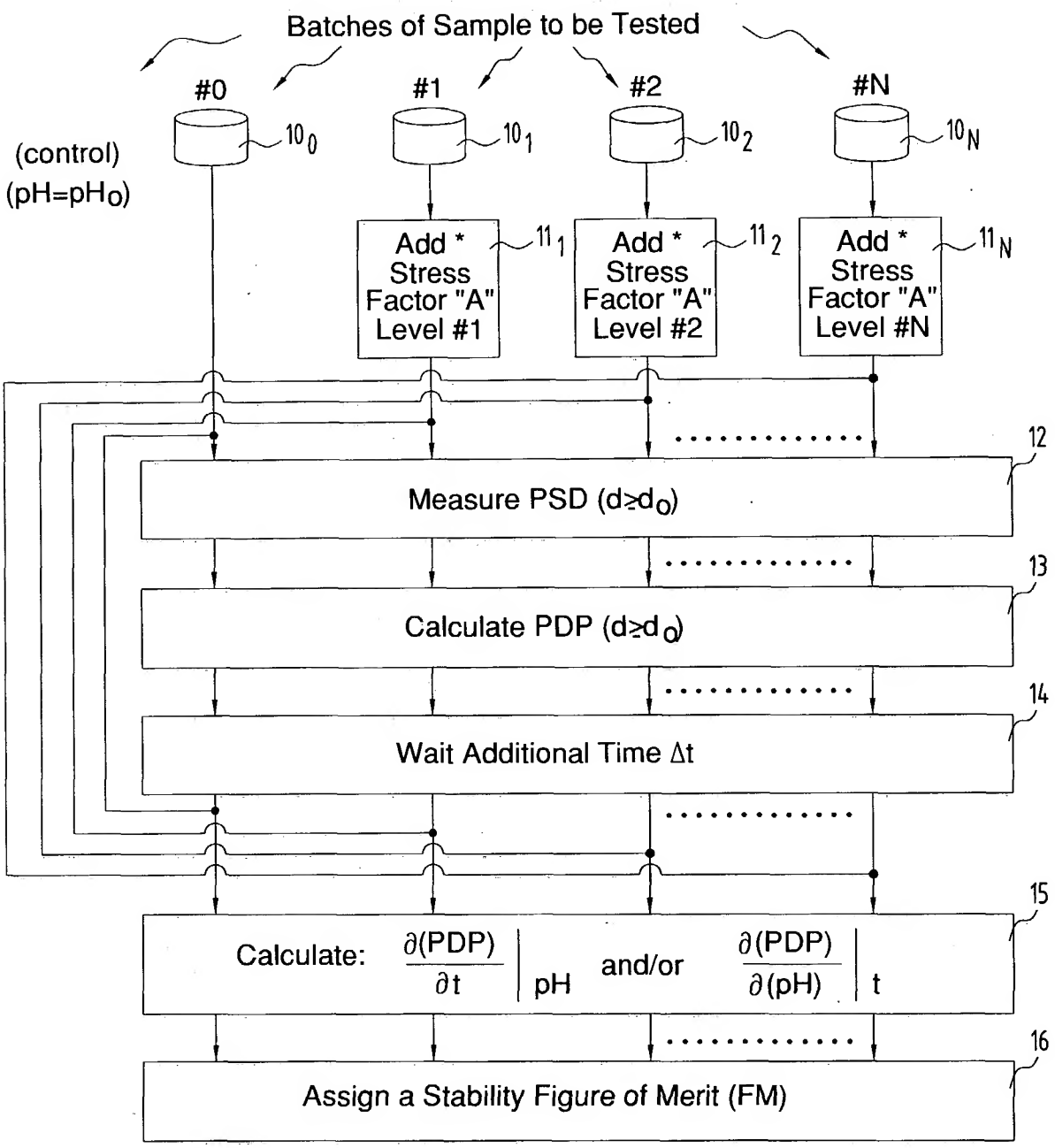


FIG.18





* Stress Factor ⇒ Level #I
I=1,2,...,N

Add $(Acid)_I$

$pH=pH_0-\Delta pH_I$

or

Add $(Base)_I$

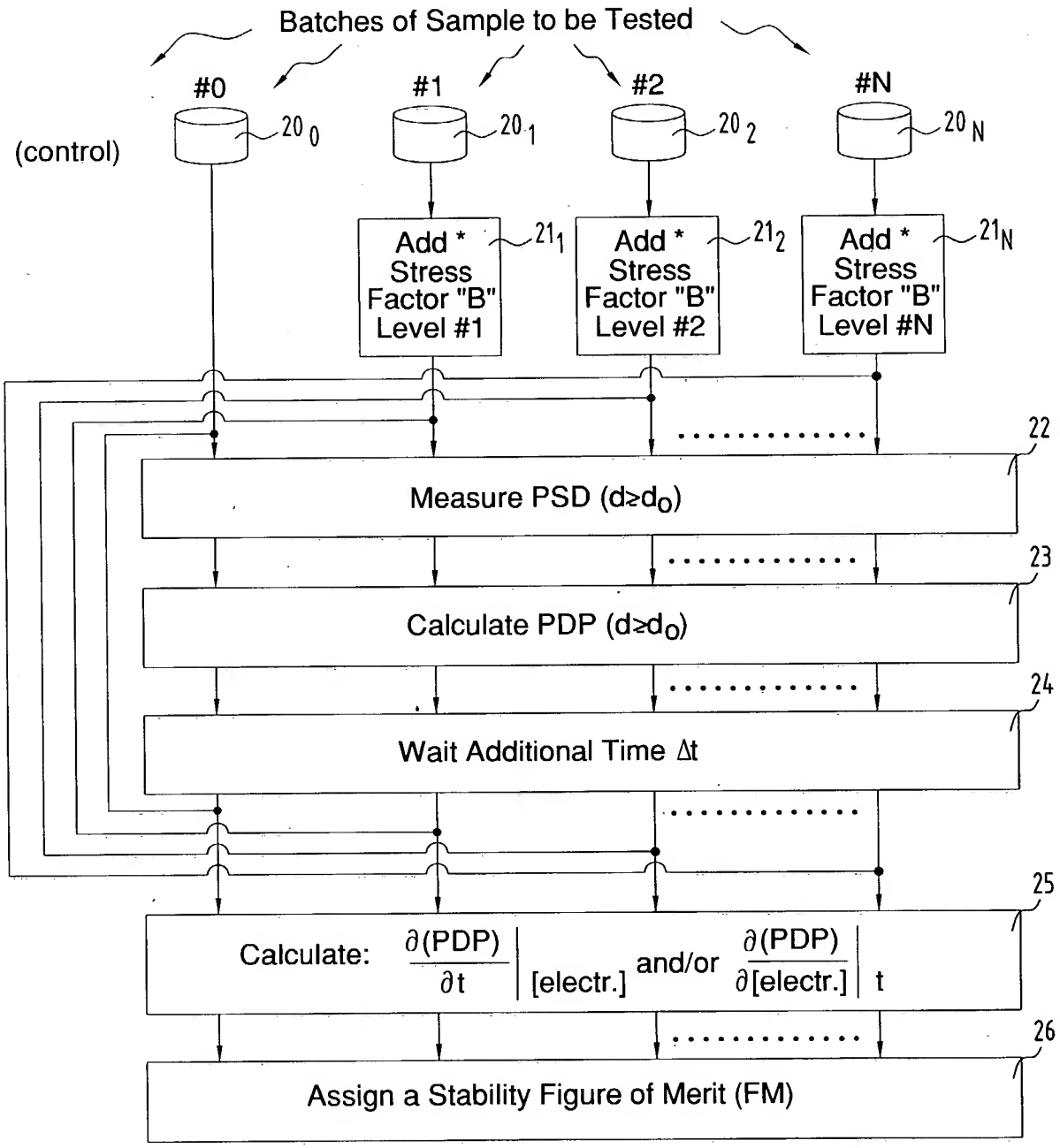
$pH=pH_0+\Delta pH_I$

where $[Acid]_1 < [Acid]_2 < .... < [Acid]_N$

or $[Base]_1 < [Base]_2 < .... < [Base]_N$

and $\Delta pH_1 < \Delta pH_2 < .... < \Delta pH_N$

FIG.19

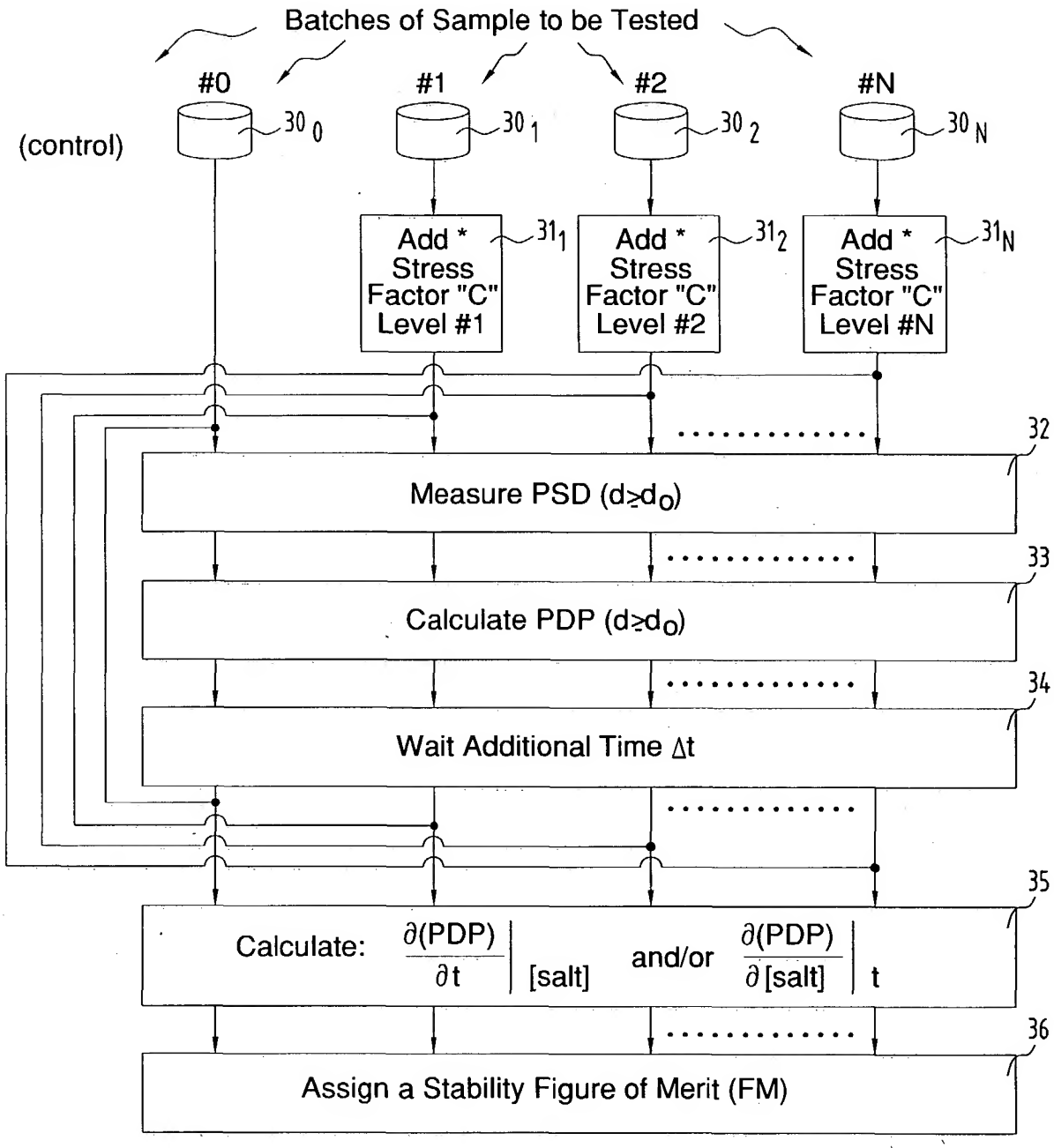


* Stress Factor $\Rightarrow$ Level #I
I=1,2,...,N

Add adsorbing electrolyte, $[electr.]_I$
(X^-, X^{--} for positively charged particles)
(X^+, X^{++} for negatively charged particles)

where $[electr.]_1 < [electr.]_2 < .... < [electr.]_N$

FIG.20



* Stress Factor ⇒ Level #I
I=1,2,...,N

Add non-adsorbing salt, $[salt]_I$ to screen inter-particle electrostatic repulsions

where $[salt]_1 < [salt]_2 < .... < [salt]_N$

FIG.21

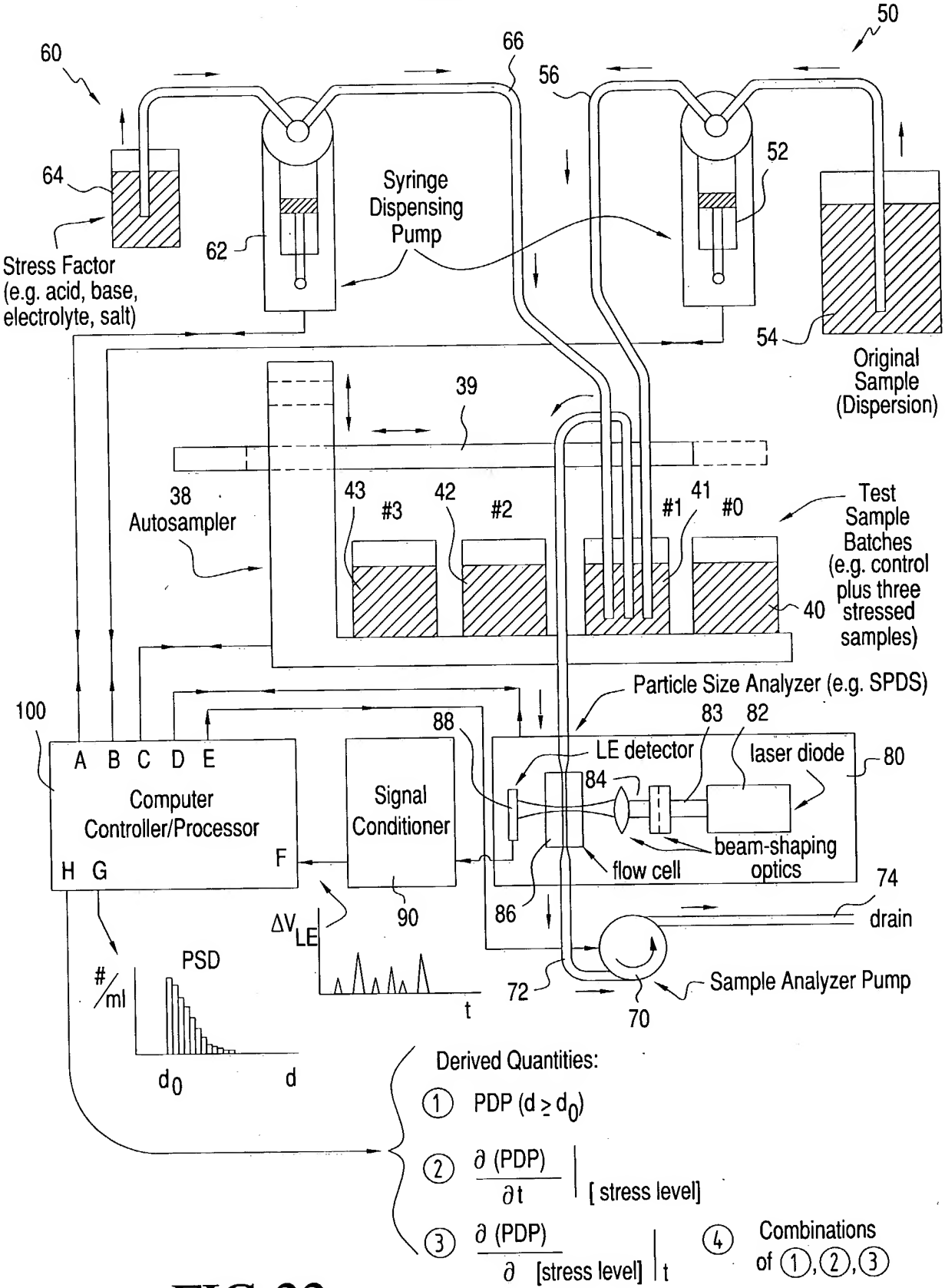

50
60
66
56
64
52
Syringe
Dispensing
Pump
62
Stress Factor
(e.g. acid, base,
electrolyte, salt)
54
Original
Sample
(Dispersion)
39
38
Autosampler
43
#3
42
#2
#1
41
#0
Test
Sample
Batches
(e.g. control
plus three
stressed
samples)
40
Particle Size Analyzer (e.g. SPDS)
100
88
83
82
A B C D E
Computer
Controller/Processor
H G
F
Signal
Conditioner
LE detector
laser diode
80
84
beam-shaping
optics
flow cell
74
drain
86
90
ΔV LE
t
PSD
#/ml
d0
d
72
Sample Analyzer Pump
70
Derived Quantities:
① PDP (d ≥ d0)
② ∂ (PDP) / ∂t | [stress level]
③ ∂ (PDP) / ∂ [stress level] | t
④ Combinations of ①, ②, ③

FIG.22

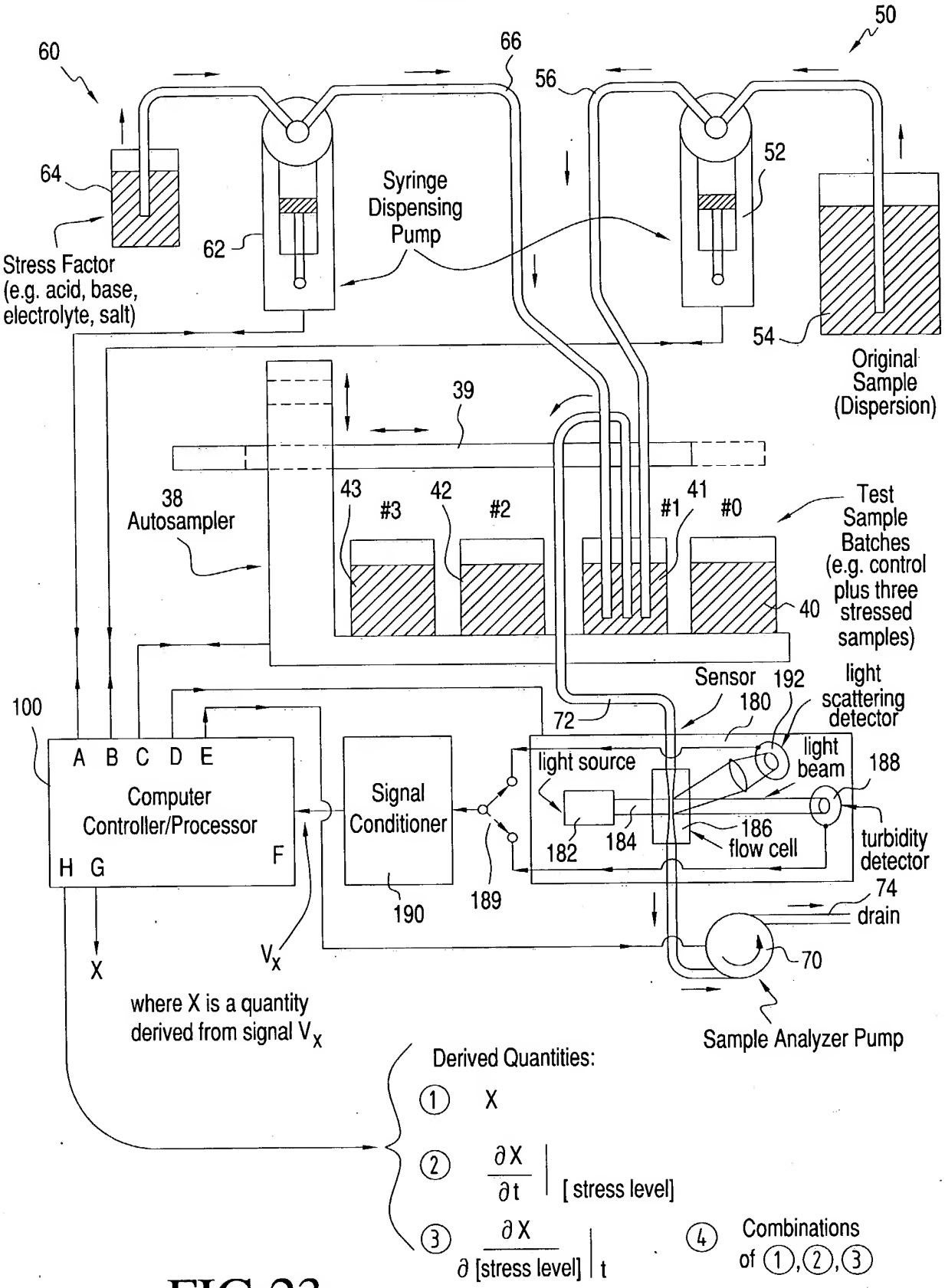

50
60
66
56
64
52
Syringe
Dispensing
Pump
62
Stress Factor
(e.g. acid, base,
electrolyte, salt)
54
Original
Sample
(Dispersion)
39
38
Autosampler
43
#3
42
#2
41
#1
#0
Test
Sample
Batches
(e.g. control
plus three
stressed
samples)
40
100
72
Sensor
180
192
light
scattering
detector
A B C D E
Computer
Controller/Processor
H G
F
Signal
Conditioner
190
light source
light
beam
188
182
184
186
flow cell
turbidity
detector
189
74
drain
70
X
V_X
where X is a quantity
derived from signal V_X
Sample Analyzer Pump
Derived Quantities:
① X
② $\frac{\partial X}{\partial t}\Big|$ [stress level]
③ $\frac{\partial X}{\partial [\text{stress level}]}\Big|_t$
④ Combinations
of ①,②,③

FIG.23

FIG.24A

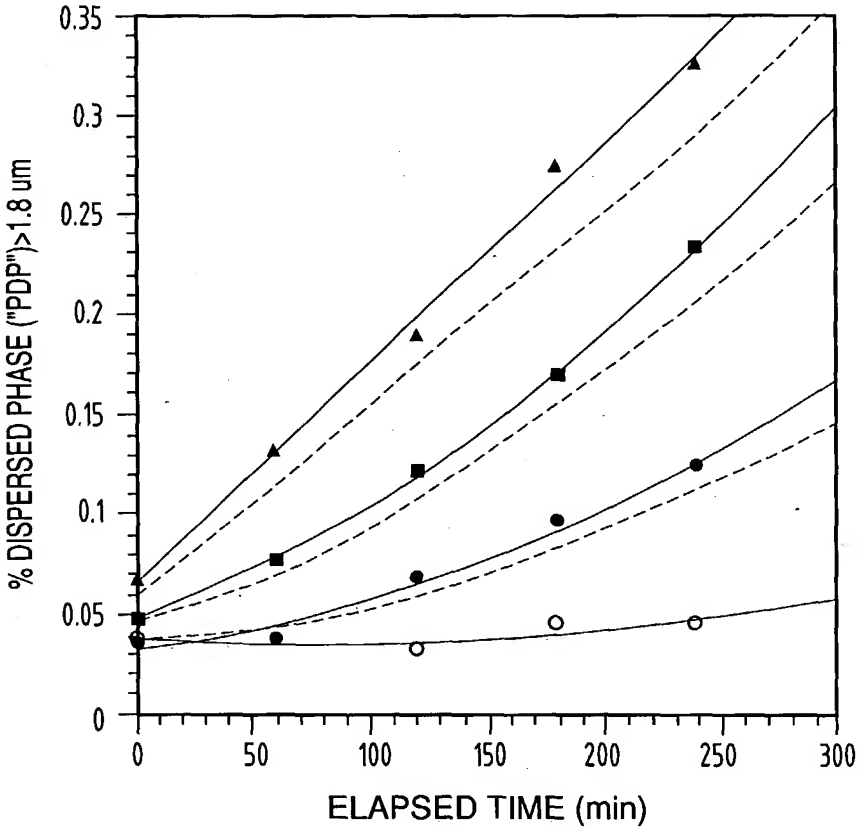


FIG.24B

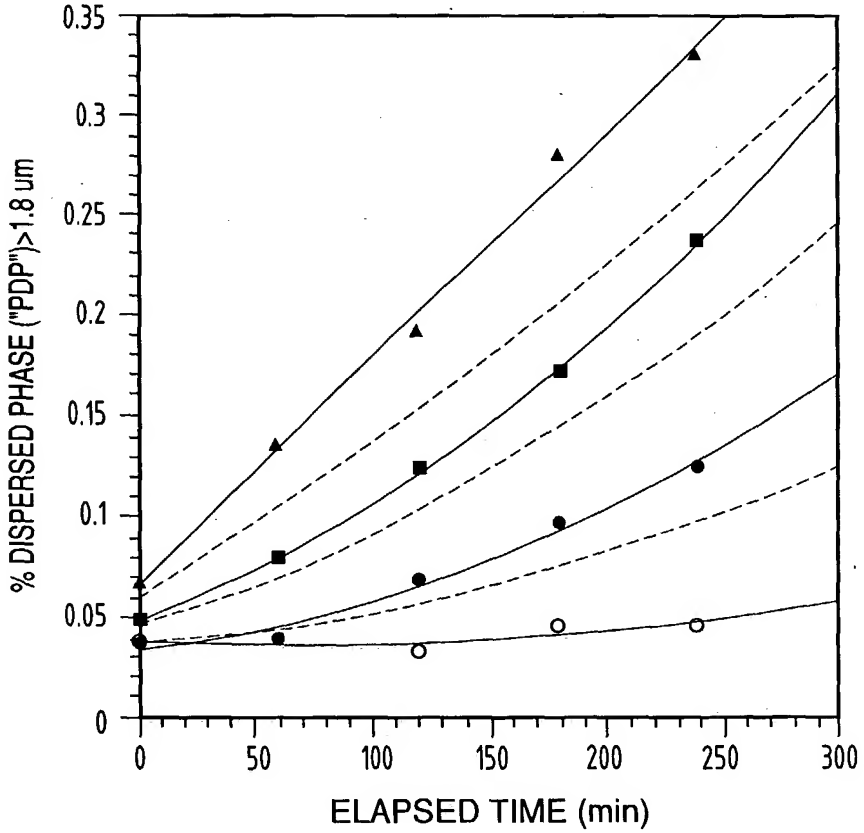


FIG.25A

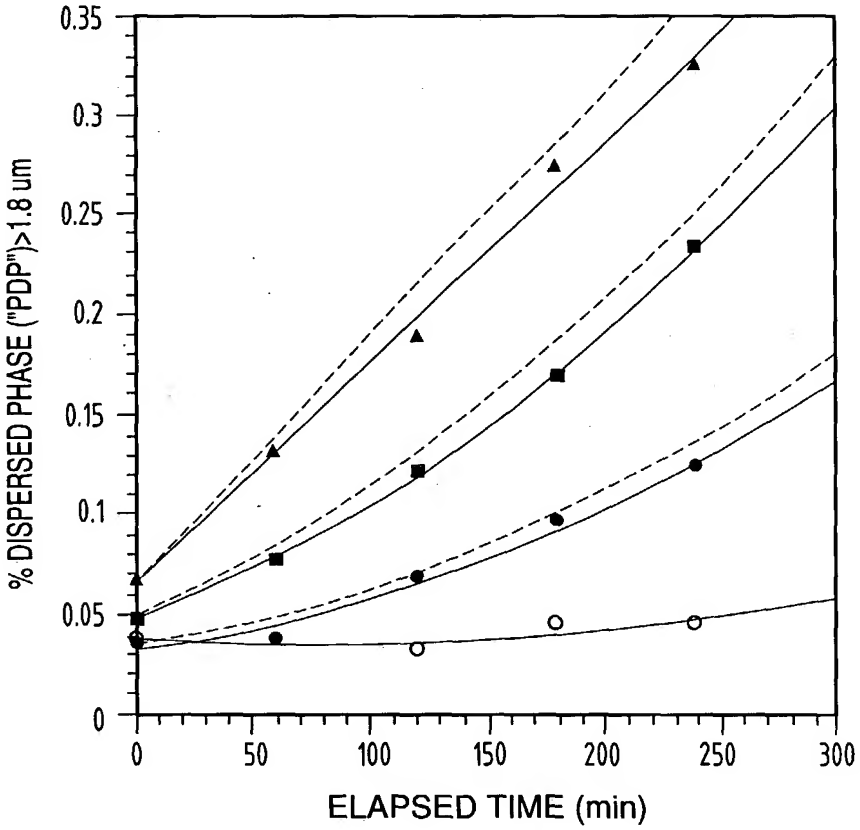
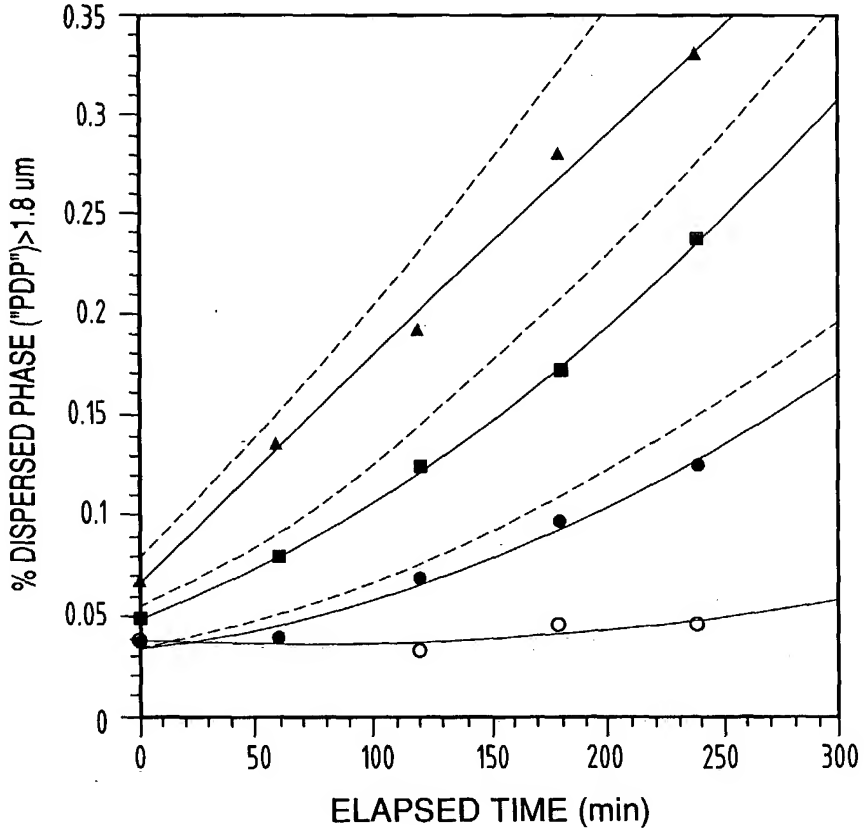



FIG.25B